

### Research Interests: Neuro-imaging, Computational neural-network modeling

- My current research is on building statistical analysis of multi-level general linear model for functional brain imaging based on compressed sensing theory. In the field of human functional neuroimaging, I am searching for novel imaging and analysis techniques of functional MRI, diffusion optical tomography (DOT), near-infrared spectroscopy (NIRS) and etc, for the advanced understanding of brain function in neurological and cognitive psychology studies as well as brain diseases such as dementia. Moreover, I'm a pioneer developer of a general-purpose functional MRI analysis toolbox, based on sparse generalized linear model with minimum description length criterion and statistical activation detection.
- Computational modeling of neural network, brain complex network studies as well as functional connectivity including default-mode network, are also my main interests, which aims to identify the human network behavior in that the regional blobs of neurons can be integrated to function by combination of their intrinsic job and interactions. Functional neuro-imaging techniques such as fMRI, electroencephalography (EEG), magnetoencephalography (MEG), multielectrode array (MEA), and diffusion water fMRI as well as structural brain imaging techniques including diffusion tensor imaging (DTI) or diffusion tensor spectroscopy (DTS), can be employed for this as well as methodological analytic methods using compressed sensing theory, machine learning, Bayesian approach, information theory and etc.
- Besides, tumor-imaging techniques with sufficient specificity and sensitivity are also of my interests, which guarantee super-high spatial and temporal resolution while background signals originated from non-target tissues and artifacts are minimized.
- For a long-term plan, development of a new brain imaging technology based on physical backgrounds including radiological physics is one of the goals in my research career. The goal constantly evokes me to build extensive knowledge of physics in existing medical imaging modalities and to erudite insights of pioneering new field of functional brain imaging.

## EDUCATION

**MS** Korea Advanced Institute of Science and Technology (KAIST)  
2009 - 2011 Department of Bio and Brain Engineering, Laboratory of Bio-Imaging and Signal Processing  
Advised by Dr. Jong Chul Ye

**BS** Yonsei University (YSU)  
2004 - 2009 Department of Radiological Science, Laboratory of Nuclear Medicine  
Advised by Dr. Yong Hyun Chung

## EXPERIENCE

**Researcher** Korea Advanced Institute of Science and Technology (KAIST)  
2011 - Present Department of Bio and Brain Engineering, Laboratory of Bio-Imaging and Signal Processing

**TA** Teaching Assistant : Bio-Signal Processing, KAIST  
2010 Spring

**Clinical Training Program** Gang Nam Severance Center Hospital, Yonsei University College of Medicine

2008 Winter I have experienced clinical practices for a radiologist in the following departments in GNSCH;

- DSA (Digital Subtraction Angiography)
- Cardiac Catheterization Lab : Cardiac Angiography, IVUS (Intravascular ultrasound)
- Diagnostic X-ray: Chest X-ray, IVP (Intravenous Pyelogram), BMD (Bone Mineral Density), and etc
- Fluoroscopy
- MRI (Magnetic Resonance Imaging)
- CT (Computed Tomography)
- Nuclear Medicine : Gamma Camera, PET-CT, Thyroid Scintigraphy
- Radiation Oncology : Tomo-Therapy, Linear Accelerator
- Oral Radiology : Dental Panorama X-ray

## PUBLICATIONS

---

### Peer-reviewed journals

- [1] **Kangjoo Lee**, Sungho Tak, and Jong Chul Ye, "A data-driven sparse GLM for fMRI analysis using sparse dictionary learning with MDL criterion", *IEEE Trans. Med. Imag.*, vol. 30, no. 5, pp. 1076-1089, May 2011
- [2] Sungho Tak, Jaeduck Jang, **Kangjoo Lee**, and Jong Chul Ye, "Quantification of CMRO2 without hypercapnia using simultaneous near-infrared spectroscopy and fMRI measurements," *Phys. Med. Biol.*, vol. 55, pp. 3249-3269, May 2010
- [3] Yong Hyun Chung, Seung-Jae. Lee, Cheol-Ha. Baek, **Kang-Joo Lee**, Yong Choi, "Characterization and optimization of a quasi-monolithic detector module with depth-encoding for small animal PET", *J. Korean Phys. Soc.*, vol. 54, no. 1, pp. 244-249, January 2009
- [4] **Kangjoo Lee**, Sungho Tak, Jong Chul Ye, "Sparse dictionary learning for fMRI activation detection using SPM and MDL criterion", *The 17<sup>th</sup> Annual Meeting of the Organization for Human Brain Mapping (OHBM)*, June 2011, Quebec City, Canada
- [5] **Kangjoo Lee**, Sungho Tak, Jong Chul Ye, "A data-driven spatially adaptive generalized linear model for functional MRI analysis", *Proc. IEEE International Symposium of Biomedical Imaging (ISBI)*, March 2011, Chicago, Illinois, USA
- [6] **Kangjoo Lee**, Jong Chul Ye, "A data-driven fMRI analysis using K-SVD sparse dictionary learning", *International Society of Magnetic Resonance in medicine (ISMRM)*, May 2010, Stockholm, Sweden
- [7] **Kangjoo Lee**, Jong Chul Ye, "Statistical parametric mapping of fMRI data using sparse dictionary learning", *Proc. IEEE International Symposium of Biomedical Imaging (ISBI)*, April 2010, Rotterdam, The Netherland
- [8] **Kangjoo Lee**, Sungho Tak, Jong Chul Ye, "A data-driven sparse GLM for a brain functional magnetic resonance imaging analysis", *Korean Society for Human Brain Mapping (KHBH) Fall 2010 Conference*, November 2010, Seoul, Republic of Korea
- [9] **Kangjoo Lee**, Jong Chul Ye, "Sparse dictionary learning for data-driven fMRI analysis", *Korean 22th Workshop on Image Processing and Image Understanding (IPIU)*, February 2010, Jeju, Republic of Korea

### Peer-reviewed conference proceedings

- [10] **Kang-Joo Lee**, Jae-Wan Kim, Ki-Hong Son, Seung-Jae Lee, Cheol-Ha Baek, and Yong Hyun Chung, "Optimization of resolution uniformity with depth-encoding detector for small animal PET", *43th The Annual Meeting of Korean Radiological Technologists Association and 10<sup>th</sup> The East Asia Conference of Radiological Technologists*, October 2008, Seoul, Republic of Korea
- [11] **Kang-Joo Lee**, Jae-Wan Kim, Ki-Hong Son, Seung-Jae Lee, Cheol-Ha Baek, and Yong Hyun Chung, "Characterization of resolution uniformity in depth-encoding PET", *The Korean Society of Radiology*, May 2008, Wonju, Republic of Korea

## SOFTWARE

---

### SPARSE-SPM 2010 - Present

To bridge the gap between theoretical analysis algorithm and practical application for various purposes, I have been contributing to building a GUI (Graphic User Interface)-based general-purpose software package based on MATLAB. I am a pioneer developer of the SPARSE-SPM, providing a powerful functional MRI analysis for task-induced fMRI or resting state functional connectivity studies, using sparse dictionary learning algorithm and statistical parametric mapping with minimum description length criterion. SPARSE-SPM is now about to be released on the BISPL website (<http://bispl.kaist.ac.kr>). [1,4-9]

### Skills

- Proficient developer, with a specialization in GUI based MATLAB, including software architecture design and batch-scripts [1,4-9]
- Knowledge of C++.
- Experienced Linux system [1-11]
- Experienced GATE Monte-carlo simulation tool for PET [3,10,11]
- Proficiency in  $\text{\LaTeX}$

## EXPERIMENT

---

### Skills

- Proficiency in practical/clinical experiments on human subjects including normal control group and dementia patients group for brain cognitive science research and drug development [1-2,4-9];

- Task-evoked block-design/event-related paradigm experiments
- Resting-state neural activity measurements

Using the following noninvasive functional brain imaging equipments such as fMRI, fNIRS or simultaneous measurements using both;

- A 3.0 T MRI system (ISOL, Republic of Korea)
- A 24 channels continuous wave near-infrared spectroscopy (NIRS) instrument (Oxymon MK III, Artinis, Netherlands) with a 3D digitizer
- A 52 channels NIRS optical brain-function imaging system (FOIRE-3000, Shimadzu, Japan)

- Experienced with optical experiments for THz time-domain spectroscopy (THz TDS)

## AWARDS

---

### Best Prize

2008 May

“Characterization of resolution uniformity in depth-encoding PET”  
International Student Session, The Korean Society of Radiology

## LICENCE

---

### RI

2007 June

A general license for managing of radioisotope (RI)  
Ministry of Education, Science and Technology, Republic of Korea

Qualification of RI license is approved by passing all exams in the following 4 subjects;

- Introduction to Nuclear Energy
- Technique for Handling Radioisotope and Radiation
- Defence against Radiation Hazard
- Regulation of Atomic Energy : Atomgesetz and Regulation of Defence against Radiation Hazard

The license is essential for treating radioisotope and radiation in any institute or commercial company, and it is enshrined in Republic of Korea Law.

## INVITED TALKS

---

2010 November

“Data-driven fMRI analysis using sparse dictionary learning”  
KAIST/SNU Joint Workshop on Sparse Data Recovery and its Application to Medical Imaging  
Medical Imaging Application Session  
Seoul National University, Republic of Korea

## CONTACT

---

Laboratory of Bio-Imaging and Signal Processing  
[zip:305-701] 402 CMS B/D, KAIST,  
335 Gwahak-no, Yuseong-gu, Daejeon, Republic of Korea

leekangjoo15@gmail.com  
Tel : +82-42-350-4360  
Fax : +82-42-350-4310